XL.—*On the Sense-organs of the Turbellaria.*

By Dr. L. Böhmig *.

Being engaged in investigations upon the Dendrocœlous and Rhabdocœlous Turbellaria, I wish here to communicate what I have at present ascertained with regard to their sense-organs, as the publication of my larger memoirs relating to the general structure must be delayed for some time in consequence of the accumulation of material and the preparation of figures.

A comparison of my preparations of *Planaria gonocephala*, Duj., with the figures and descriptions which J. Carrière has given † of the eyes of *Planaria polychroa* and *Dendrocœlum lacteum* has convinced me that I am able to furnish some fresh details.

The position of the eyes in *Planaria gonocephala* is the same as in all the Triclades known to me, namely in the anterior extremity of the body, described as the head. *Planaria gonocephala* has a triangular head, and the eyes lie in its middle. The longitudinal diameter of the eyes amounts to about 0·18 millim., that of the width and height about 0·1 millim. Sections through the eye allow us to recognize what follows.

Each eye consists of a pigment-capsule and a nervous apparatus; the pigment-capsule, the greater diameter of which is parallel to the longitudinal axis of the animal, consists of small blackish-brown spherules. The convex side of the capsule is surrounded by a narrow border of finely granular plasma, in which a number of distinct round nuclei are to be perceived. The great number of nuclei indicates that the pigment-capsule has originated from several cells, in opposition to the eyes of the Polyclades, in which only one nucleus occurs in this plasmatic border.

Before the opening of the pigment-capsule is the so-called *ganglion opticum*, which consists of a central ball of dotted substance, around which peripheral ganglion-cells (retinal cells) are grouped. The central nervous system is in connexion with the ball of dotted substance through the *nervus opticus*. This originates from a part of the cerebrum where the dotted substance is characterized by greater fineness and a more homogeneous appearance. The same thing occurs in

* Translated from the 'Zoologischer Anzeiger,' no. 260, 12th September, 1887, pp. 484–488.

† J. Carrière, "Die Augen von *Planaria polychroa*, O. Schm., und *Polycelis nigra*, Ehrb.," in Archiv für microsc. Anat. Bd. xx. Heft 2; and "Die Sehorgane der Thiere."

many Gasteropoda, e. g. *Helix pomatia*, in which also the part of the dotted substance from which the sense-nerves and, indeed, especially the *nervus opticus* are given off is distinguished from the rest by the above-mentioned properties.

The cells of the *ganglion opticum* possess a large nucleus, which is surrounded by only a narrow plasmatic border. They are unipolar, but this process divides immediately into a number of smaller ones, which, so far as I could ascertain, all but one enter into the dotted substance, probably to unite here with each other and with the fibres of the *nervus opticus*. One of the fibres produced by the division of a cell-process turns, however, towards the aperture of the pigment-capsule, and before entering it undergoes a more or less strong geniculation. In the cavity of the pigment-capsule it swells into the so-called terminal club. These terminal clubs completely fill up the pigment-capsule. Hitherto they have been described as hyaline structureless formations; in *Planaria gonocephala* they present a more complex structure. The fibres in question become thickened first of all into a small pestle-like formation, which sometimes shows a fine longitudinal striation. Upon this, like a hood, is seated a crescentiform, finely granulated, terminal piece, and between the two there is intercalated a thin, hyaline, intermediate plate. In *Planaria Iheringii* * I do not find the intermediate plate; in this the terminal piece enveloped the club for a certain distance.

I have been unable to detect any lenses or lentiform structures. I suppose that the function of the lens is performed by the parenchymatous tissue situated between the retina and the epithelium, which during life is viscous and transparent. I regard as the retina the *ganglion opticum* and the terminal clubs, as has already been done by others.

Among the Rhabdocœlous Turbellaria I have hitherto particularly devoted my attention to the Alloiocœla. Among these the Plagiostomidæ, when compared with the Monotidæ, possess the more complex eyes, and of these two or four.

Vorticeros auriculatum possesses two eyes which are placed in direct contact with the brain, as indeed is the case in all other forms. The pigment of the pigment-capsule is, in the Plagiostomidæ, very frequently connected by pigment-cords with the pigment of the body, so also in *Vorticeros auriculatum*. The aperture of the pigment-capsule is turned

* *Planaria Iheringii*, a new Tricladous Turbellarian from Brazil, described by the author in the same number of the 'Zoologischer Anzeiger.'

towards one side; its larger axis is placed perpendicularly to the long axis of the body.

The pigment-capsule of each eye is divided by a median pigmental septum into an anterior and a posterior chamber. I have been unable to detect any plasmatic border with nuclei around the pigment-capsule; nevertheless it does not follow that it is really deficient. The pigmental septum of course causes the pigment-capsule to possess two apertures, each of which is closed by a lentiform cell with a distinct nucleus and nucleolus which lies upon it. This cell, however, is not placed close to the margin of the capsule, but leaves a small space free. The cavity of each half of the pigment-capsule is occupied by fine bacilli which stand perpendicularly to the long axis of the capsule. They leave a small central canal free, in which, in certain preparations, I observed extremely fine fibrils. Between the bacilli there is a delicate homogeneous intermediate substance. In the vicinity, especially at the margin of the capsule, there are numerous small cells which are very similar to the ganglion-cells of the cerebrum, and are only distinguished from them by a small difference in size. They possess fine processes, of which I assume that they unite with the bacilli; but this I have not seen. These cells would then have to be regarded as retinal cells.

Enterostoma striatum possesses four eyes, two small anterior and two larger hinder ones. They all lie upon the cerebrum, which, in contrast to all other Alloiocœla examined by me, is cut off from the surrounding tissues by a very sharp fine outline. *Enterostoma striatum* presents many peculiarities: thus, for example, it possesses an unpaired, dorsally-placed ovary. In the reniform pigment-capsule two globular pale structures lie close together, and these in very well-preserved specimens show a distinct longitudinal striation. This striation is due to exceedingly delicate bacilli, which are enclosed in a delicate intermediate substance. In front of the aperture of the pigment-capsule I see here two large cells which produce a closure similar to that of the lentiform cells of *Vorticeros auriculatum*. Small cells, on which I could here and there detect fine processes, lie before and in the vicinity of the large ones. The small cells stain, especially with osmium-carmine, much more strongly than the large ones, and also more intensely than the ganglion-cells of the cerebrum. In one case I was able to trace such a fine process into the neighbourhood of the striated globular structures. I regard them therefore in this case also as retinal cells. The larger pale cells, both in *Vorticeros auriculatum* and in *Enterostoma striatum*, may, perhaps, be regarded as lens-cells, as it

is certainly possible that they really act as refractive media, or at any rate are homologous in their origin with the lenses of other eyes of Rhabdocœla.

The eyes of *Plagiostoma ochroleucum*, *maculatum*, *reticulatum*, and *sulphureum* agree essentially in their structure with the eyes of *Enterostoma striatum*. Smaller differences, of course, exist, and more will probably be found on further investigation. Thus, for example, the contents of the pigment-capsule in *Plagiostoma ochroleucum* do not consist of two globular structures, as in *Enterostoma striatum*, but only of one. The tendency to break up into several pieces in the eyes of *Plagiostoma sulphureum* is also known.

I must, however, specially notice the eyes of *Plagiostoma Girardi*. In this animal the contents of the pigment-capsule consist of two clearly distinguishable substances. The larger posterior portion of the capsule is filled with a perfectly homogeneous substance which only becomes faintly coloured by reagents. In front of this there is a narrow band which does not stain at all, but shows a distinct horizontal striation. The limit of this band is very sharp and distinct both inwardly and outwardly. Before the pigment-capsule there is an aggregation of cells, of which the central ones are larger than the peripheral. They also show a difference in their behaviour towards colouring materials, the smaller cells stain more strongly than the large central ones. The figure given by von Graff, in his monograph of the Turbellaria, of the eyes of *Plagiostoma Girardi* does not agree with my representation. In my opinion von Graff had before him indifferently preserved specimens, and crushed preparations in this case only too readily give rise to illusions. What von Graff describes as the lens is undoubtedly the contents of the pigment-capsule shrivelled during preparation, and which I regard as the terminal nervous apparatus, I believe, with some justice.

A. Lang * and I. Iijima † mention in the *Planariæ* examined by them a nervous plexus, which is readily demonstrable, especially at the back of the animal. In *Planaria gonocephala*, also, there is both at the dorsal and at the ventral surface a subcutaneous nervous plexus, which may be particularly demonstrated in the cephalic part, and here again very distinctly in the auricular processes. In connexion with this subcutaneous nervous plexus I have observed in the auricular processes an apparatus which is probably to be interpreted as a terminal nervous apparatus.

* Das Nervensystem der Tricladen.

† Untersuchungen über den Bau und die Entwicklungsgeschichte der Süsswasser-Dendrocœlen.

On the dorsal surface of the auricles there is a pit about 0·03 millim. deep, and 0·025 millim. in length and breadth, diminishing downwards, which is cut off from its surroundings by a sharp and fine contour. At the bottom of the pit numerous nervous fibres enter from the subcutaneous nervous plexus, and these run to a reniform body which occupies the middle third of the depression. This body is of fibrous structure, and the fibres composing it are apparently confusedly intermixed. With picrocarmine it stains yellowish red, and much more intensely than the dotted substance which otherwise resembles it in appearance. From the free surface of this body arise a number of setæ, about 0·025 millim. in length and 0·002 millim. in thickness, which project beyond the cilia of the surrounding epithelial cells. At their free extremities these filaments are furnished with small knobs. The inferior third of the pit is only partially filled by the entering nerve-fibres; the rest is occupied by a large cell about 0·008 millim. in diameter, possessing a distinct nucleus which only stains faintly. As to the function pertaining to this organ I am quite in the dark; it is perhaps a tactile organ.

Hitherto I have been unable to find any other terminal apparatus of the nerves either in Triclades or in Rhabdocœla, with the exception of the tactile apparatus at the anterior extremity of the body in *Graffilla muricicola*, already described by me in detail; nevertheless I have often been able to trace the nerves as far as the epithelium. The only other things that I might mention are the small pale pencils which I have found among the epithelial cells of the auricular processes in *Planaria gonocephala*, and which are perhaps connected with nerve-fibres.

XLI.—*Notes on Batrachians from Perak.*

By Dr. A. Günther, F.R.S.

[Plate XVI.]

Mr. L. Wray, Jun., of the Perak Museum has again forwarded to the British Museum a small collection of Batrachians which supplies some additional information for our knowledge of the Reptilian fauna of the interior of the Malayan Peninsula. I beg to offer the following notes on some of the species sent.